

REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the Office Action of September 5, 2008 is respectfully requested.

By this Amendment, claims 1 and 5 have been amended. Thus, claims 1, 4, 5 and 8-10 are currently pending in the application. No new matter has been added by these amendments.

On pages 3-10 of the Office Action, the Examiner rejected claims 1, 4, 5 and 8-10 under 35 U.S.C. § 103(a) as being unpatentable over Borsboom et al. (US 4,981,661) in view of Tang et al. (US 6,019,954) and Forg et al. (US 5,660,807). For the reasons discussed below, it is respectfully submitted that the present claims are clearly patentable over the prior art of record.

Amended independent claim 1 recites a COS treatment apparatus for a gasified gas containing H_2S , H_2O , O_2 , and CO . The COS treatment apparatus of claim 1 includes a first reactor into which the gasified gas is to be introduced, with the gas having a temperature of at least 300°C , and a second reactor located at a downstream side of a gasified gas flow with respect to the first reactor. Claim 1 also recites that the first reactor comprises an O_2 removal catalyst for accelerating the following reaction: $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$, with the O_2 removal catalyst consisting of TiO_2 and Cr_2O_3 or consisting of TiO_2 and NiO . Further, claim 1 recites that the second reactor comprises a COS conversion catalyst.

Amended independent claim 5 recites a COS treatment method for a gasified gas containing H_2S , H_2O , O_2 , and CO . The method of claim 5 includes removing O_2 from the gas by using an O_2 removal catalyst consisting of TiO_2 and Cr_2O_3 or consisting of TiO_2 and NiO at a gas temperature of at least 300°C to accelerate the following reaction: $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$. The method of claim 5 also includes, after the removing of O_2 from the gas, converting COS contained in the gas to H_2S by using a COS conversion catalyst.

Borsboom discloses a process for removing sulfur compounds from a CO containing gas. In particular, Borsboom discloses that O_2 is removed from a gasified gas by the hydrogenation of O_2 under a Co-Mo catalyst prior to the hydrolysis of COS. Borsboom also discloses that the hydrogenation of O_2 occurs in accordance with the following reaction: $0.5\text{O}_2 + \text{H}_2 \rightarrow \text{H}_2\text{O} + \text{heat}$ (Equation (6) of Borsboom).

However, as noted by the Examiner on page 3 of the Office Action, Borsboom does not

disclose *an O₂ removal catalyst consisting of TiO₂ and Cr₂O₃ or consisting of TiO₂ and NiO*, as required by independent claims 1 and 5. Further, it is noted that Borsboom does not disclose or suggest that a Co-Mo catalyst is an O₂ catalyst which is capable of accelerating the reaction of: $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$, as required by independent claims 1 and 5.

Tang discloses catalysts for the conversion of carbon monoxide with steam into carbon dioxide and hydrogen. In particular, Tang discloses a catalyst which includes a carrier having TiO₂ and at least one catalytically active metal compound selected from the group consisting of oxides and sulfides of Co, Ni, Mo and W. On page 4 of the Office Action, the Examiner asserts that it would have been obvious to one of ordinary skill in the art to modify the O₂ removal catalyst of Borsboom to be a TiO₂ catalyst carrying NiO in order to improve the conversion of carbon monoxide with steam into carbon dioxide and hydrogen.

However, Tang does not disclose or suggest that selecting only one catalytically active metal compound from the group consisting of oxides and sulfides of Co, Ni, Mo and W improves the conventional Co-Mo system catalyst. Rather, Tang discloses an improved Co-Mo system catalyst, which requires Co or Ni and Mo or W (see column 1, lines 33-36; and column 3, lines 30-31), and does not disclose or suggest that the conventional Co-Mo system catalyst is improved by providing only one of Co, Ni, Mo and W. Accordingly, one of ordinary skill in the art would not have had a reasonable expectation of success based on Tang in selecting only one catalytically active metal compound from the group consisting of Co, Ni, Mo and W to provide a catalyst consisting of TiO₂ and NiO, as required by claims 1 and 5.

Further, Tang only discloses a catalyst for the conversion of carbon monoxide with steam into carbon dioxide and hydrogen. Thus, Tang, like Borsboom, does not disclose a catalyst which is capable of accelerating the reaction of: $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$, as required by independent claims 1 and 5.

Forg discloses a process for the removal of HCN from gas mixtures. In particular, Forg discloses a catalyst including TiO₂ and Cr₂O₃ for decomposing HCN and COS by hydrolysis, and for simultaneously suppressing the formation of COS from H₂S and CO₂ in the gas mixture. However, Forg does not disclose that a catalyst including TiO₂ and Cr₂O₃ is *an O₂ removal catalyst for accelerating a reaction of $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ at a temperature of at least*

300°C, as required by independent claims 1 and 5. Accordingly, it would not have been obvious to one of ordinary skill in the art to use the catalyst including TiO_2 and Cr_2O_3 of Forg as an O_2 removal catalyst for accelerating a reaction of $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$ because Forg only discloses the catalyst including TiO_2 and Cr_2O_3 as being a catalyst for decomposing HCN and COS.

Further, as indicated above, Forg discloses that a catalyst including TiO_2 and Cr_2O_3 decomposes HCN and COS by hydrolysis, and simultaneously suppresses the formation of COS from H_2S and CO_2 in the gas mixture. Therefore, Forg teaches away from using a catalyst including TiO_2 and Cr_2O_3 as an O_2 removal catalyst for accelerating a reaction of $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$, because Forg disclose that a catalyst including TiO_2 and Cr_2O_3 suppresses the formation of COS from H_2S and CO_2 in the gas mixture.

Therefore, for the reasons presented above, it is believed apparent that the present invention as recited in independent claims 1 and 5 is not disclosed or suggested by the Borsboom reference, the Tang reference and the Forg reference taken either individually or in combination. Accordingly, a person having ordinary skill in the art would clearly not have modified the Borsboom reference in view of the Tang reference and the Forg reference in such a manner as to result in or otherwise render obvious the present invention of independent claims 1 and 5.

Independent claim 9 recites a COS treatment apparatus for a gasified gas containing H_2S , H_2O , O_2 , and CO. The treatment apparatus of claim 9 includes a reactor into which the gasified gas is to be introduced, with the reactor comprising *a TiO_2 catalyst carrying Cr_2O_3 and BaO*. Claim 9 also recites that *the TiO_2 catalyst carrying Cr_2O_3 and BaO is an O_2 removal catalyst for accelerating the following reaction: $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$, and that the TiO_2 catalyst carrying Cr_2O_3 and BaO is a COS conversion catalyst*.

Independent claim 10 recites a COS treatment method for a gasified gas containing H_2S , H_2O , O_2 , and CO. The method of claim 10 includes removing O_2 from the gas by *using a TiO_2 catalyst carrying Cr_2O_3 and BaO to accelerate the following reaction: $2\text{H}_2\text{S} + 2\text{CO} + \text{O}_2 \rightarrow 2\text{COS} + 2\text{H}_2\text{O}$* . The method of claim 10 also includes *simultaneously converting COS to H_2S by using the TiO_2 catalyst carrying Cr_2O_3 and BaO*.

It is noted that none of the Borsboom, Tang and Forg references discloses a catalyst comprising BaO. Therefore, none of the Boorsboom, Tang and Forg references discloses *a reactor comprising a TiO₂ catalyst carrying Cr₂O₃ and BaO*, as required by independent claim 9. Similarly, none of the Borsboom, Tang and Forg references discloses a method which includes *removing O₂ from the gas by using a TiO₂ catalyst carrying Cr₂O₃ and BaO*, as required by independent claim 10. In this regard, it is noted that on pages 8 and 10 of the Office Action, the Examiner asserts that it would have been obvious to one of ordinary skill in the art to modify "the combined teachings of Borsboom et al and Tang et al such that the reactor comprising a TiO₂ catalyst carrying Cr₂O₃ and BaO..." so as to arrive at the invention of claims 9 and 10, but does not indicate how the applied prior art discloses or suggests a TiO₂ catalyst carrying Cr₂O₃ and BaO, as required by independent claims 9 and 10.

Further, as none of the Boorsboom, Tang and Forg references discloses a reactor comprising a TiO₂ catalyst carrying Cr₂O₃ and BaO, none of the Boorsboom, Tang and Forg references discloses or suggests that a TiO₂ catalyst carrying Cr₂O₃ and BaO *is an O₂ removal catalyst for accelerating the following reaction: $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$, and wherein the catalyst is a COS conversion catalyst*, as required by independent claim 9. For the same reason, none of the Borsboom, Tang and Forg references discloses or suggests a method which includes *removing O₂ from the gas by using a TiO₂ catalyst carrying Cr₂O₃ and BaO to accelerate the following reaction: $2H_2S + 2CO + O_2 \rightarrow 2COS + 2H_2O$, and simultaneously converting COS to H₂S by using the TiO₂ catalyst carrying Cr₂O₃ and BaO*, as required by independent claim 10.

Therefore, for the reasons presented above, it is believed apparent that the present invention as recited in independent claims 9 and 10 is not disclosed or suggested by the Borsboom reference, the Tang reference and the Forg reference taken either individually or in combination. Accordingly, a person having ordinary skill in the art would clearly not have modified the Borsboom reference in view of the Tang reference and the Forg reference in such a manner as to result in or otherwise render obvious the present invention of independent claims 9 and 10.

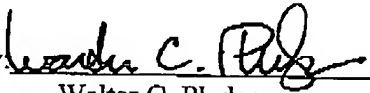
Therefore, it is respectfully submitted that independent claims 1, 5, 9 and 10, as well as claims 4 and 8 which depend therefrom, are clearly allowable over the prior art of record.

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is clearly in condition for allowance. An early notice to that effect is respectfully solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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